# The Seasonal Occurrence of Some Prominent Zooplankton Species in Rough Firth. II. Chaetognatha

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Chaetognatha or arrow worms can occur in huge numbers in the plankton. They are transparent and have a very distinctive appearance (Fig. 1). The head has two pigmented eyes on the upper surface and two sets of bristles on the underside which function as jaws for seizing prey. The trunk bears two pairs of horizontal lateral fins and the tail ends in another horizontal fin. Prey items are usually copepods but other small animals, such as medusae, crustaceans and fish larvae are also taken. The fins are thought to play no part in locomotion but simply act as flotation devices (Pierrot-Bults and Chidgey, 1988).

Arrow worms are hermaphroditic with ovaries in the trunk and testes in the tail. Cross fertilisation takes place and the eggs are fertilised *in situ*. The eggs are then released into the water. A larva about 1mm long is set free from each and this develops gradually into the adult.

Two species occur in Rough Firth, Kirkcudbrightshire: *Sagitta setosa* J. Müller and *S. elegans* Verrill. Older individuals are easily recognised (Fig. 1). Younger immature stages lack the distinctive sperm vesicles, but the thread-like gut of *S. setosa* is still a valuable aid to identification and with very small specimens (under 4mm long) the vacuolated gut cells and upward retraction of the head of *S. elegans* after preservation are especially helpful characteristics.

## Methods

The same methods were used as reported in Skinner (1995). In addition, sea surface temperatures were taken at the start and end of each tow. From March 1985 surface salinities were recorded at the

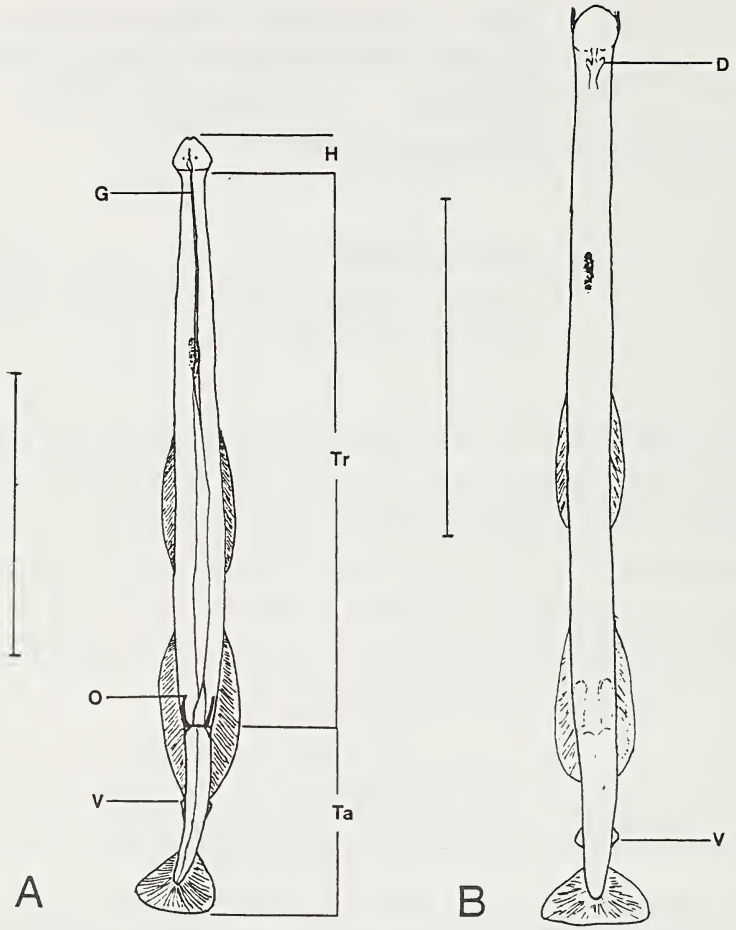


**Fig. 1: Drawings of (A) *Sagitta setosa* (dorsal side) and (B) *S. elegans* (ventral side). D, anterior gut diverticula; G, gut; H, head; O, ovary, Ta, tail; Tr, trunk; V, sperm vesicle (wedge-shaped in *S. setosa* and cone-shaped in *S. elegans*). Scale bars - 5mm.**

same time, using a purpose-built hydrometer accurate to about 1 part per thousand. The numbers of *Sagitta* caught were standardised for a 15 min. hauling time and their lengths overall measured. Where numbers were large a random sub-sample of convenient size was taken.

Identifications were made with the help of Fraser (1957).

## Results and discussion

The results are summarised in Figs. 2-4.

The total number of *Sagitta* caught throughout the survey amounted to 61,148 of which only 1,826 or about 3% were *S. elegans*. *S. setosa* is a neritic species associated with water of low salinity whereas *S. elegans* is characteristic of mixed oceanic and coastal waters such as occur in the Irish Sea (D.I. Williamson in Bruce *et al.*, 1963) and it was the unexpected occurrence of *S. elegans* that prompted the writer to take measurements of surface salinity. According to Fraser (1952) the presence of *S. setosa* is correlated with a temperature range of 5-16°C and a salinity range from "about 35 parts per thousand to at least as low as 29 parts per thousand", whereas *S. elegans* tends to be associated with temperatures of 0-13°C and salinity values about 35 parts per thousand and "its extension into lower salinity waters is much less than with *S. setosa*". The results are in broad agreement with this: peak numbers of *S. setosa* occurred earlier than peak numbers of *S. elegans* and few of the former were caught in February when the water temperature was at its lowest (less than 5°C).

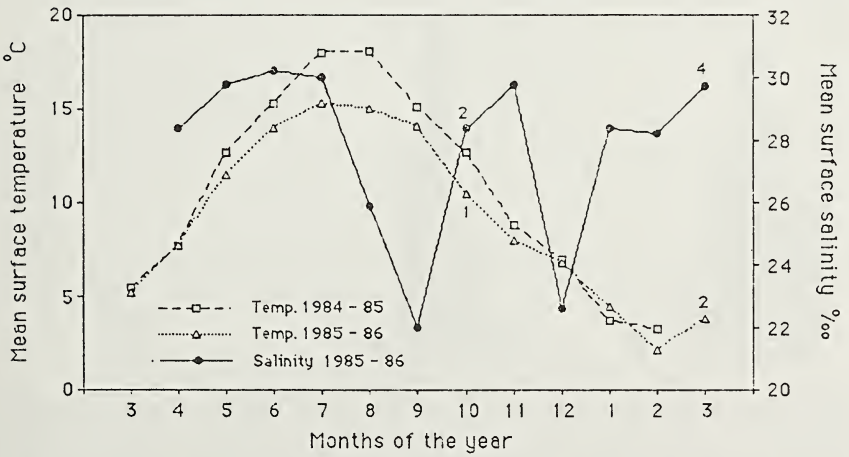


**Fig. 2: Mean surface temperature and salinity. Each value is the mean of usually four observations. Only one observation was made in October 1985, and only two in March 1986.**

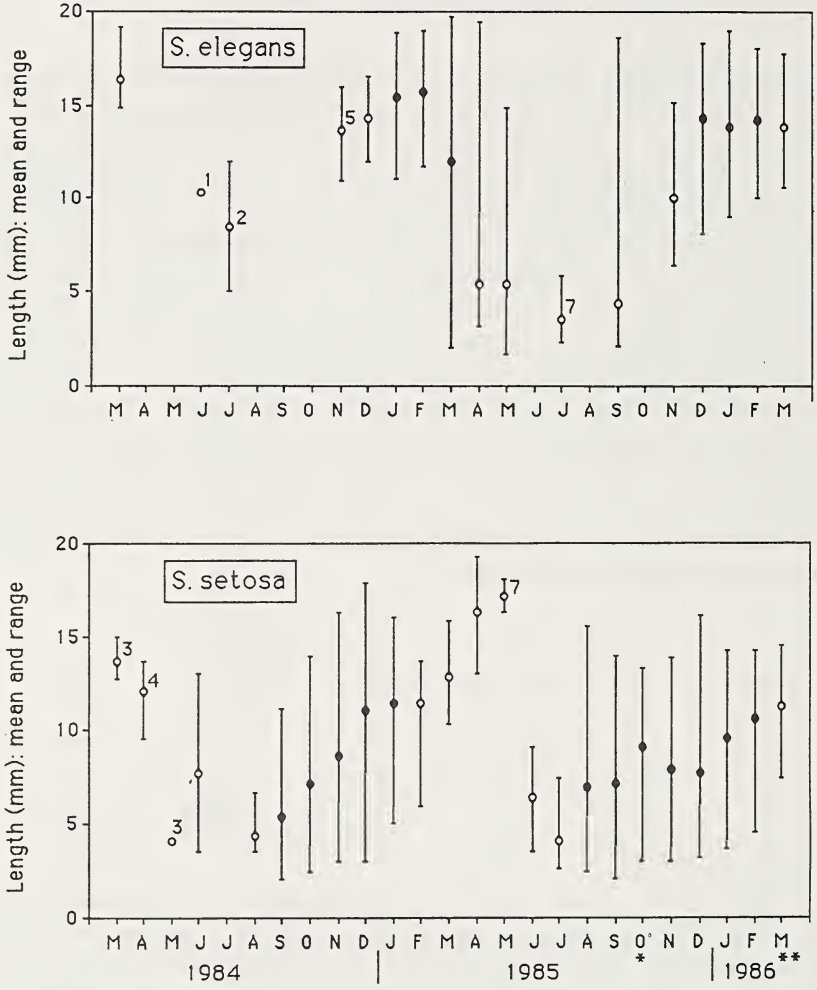


**Fig. 3: Size data from *S. setosa* and *S. elegans*. Mean length and range of length are given for each month. When the total number of animals was below 10, the actual number is given beside the mean; for *S. setosa*, open circles indicate numbers from 10-95, filled circles 207-1751; for *S. elegans*, open circles indicate numbers from 10-50, filled circles 90-193. Only one sample was taken in October 1985, and only two in March 1986.**

The results also show that there is a gradual increase in the size of *S. setosa* as the season progresses from autumn to winter; this is most noticeable in the results for 1984-85. The less striking increase shown in 1985-86 may be connected to the lower water temperature but no doubt other factors are involved.

*S. elegans* arrived in significant numbers in the winter only when more turbulent conditions cause greater mixing of different water

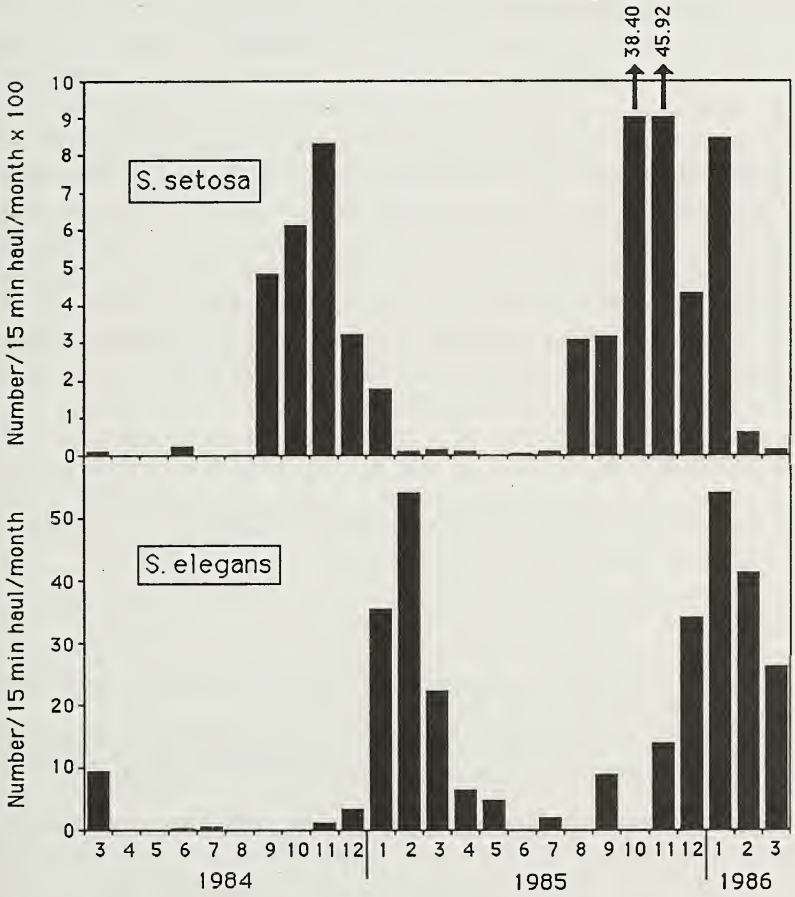


**Fig. 4: Seasonal occurrence of *S. setosa* and *S. elegans*. Each value represents the mean of usually four weekly samples taken each month from March 1984 to March 1986. Only one sample was taken in October 1985, and only two in March 1986).**

masses in the Irish Sea and adjacent areas. These were of greater size than the few specimens caught during the summer months so the evidence, scanty though it is, does suggest a pattern of development similar to that of *S. setosa*.

Nevertheless, there were some striking differences between the two species. Observations made on live samples during 1985-86 showed that by December/January *S. elegans* was at a more advanced stage than *S. setosa* as shown by size of the ovaries, the well-developed seminal vesicles, the abundance of spermatocytes (which could be seen circulating in some specimens), and the shedding of sperm by several specimens during February. In contrast, few or no signs of spermatocytes were seen in *S. setosa* during the winter months and sperm shedding was observed only in September and October 1984 and May, August and September 1985. Furthermore, the earliest appearance of the smallest specimens (under 4mm) of *S. elegans* in the catches was March 1985 and these continued to be caught up to September, whereas similar sized *S. setosa* were first caught in May 1984 through to December and from June 1985 to January 1986. All these points indicate that the winter population of *S. setosa* was immature, spawned mainly in the summer months outwith the Rough Firth area, and started and stopped spawning later than *S. elegans*.

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